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THE MAGNAVOX COMPANY, Plaintiff, vs. CHICAGO DYNAMIC INDUSTRIES, et al, Defendants	No. 74 C 1030 and 74 C 2510

Tuesday, December 28, 1976

2:10 p.m.

Parties met pursuant to recess.

PRESENT:

MR. ANDERSON
MR. WILLIAMS
MR. ALLEGRETTI
MR. BRIODY

MR. GOLDENBERG
MR. RIFKIN

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THE COURT: Gentlemen, have there been satisfactory arrangements made for your exhibits overnight? Were there last night? Did you leave them in the courtroom?

MR. ANDERSON: We left them here.

THE COURT: That is what I was going to suggest, if you hadn't.

MR. ANDERSON: The plaintiffs will call as their next witness Dr. William Ribbens.

WILLIAM BENNETT RIBBENS,

called as a witness by the plaintiff herein, having been first duly sworn, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. ANDERSON:

Q For the record, would you state your full name?

A William Bennett Ribbens.

Q Where do you reside?

A In Ann Arbor, Michigan.

Q What is your home address?

A 2461 Towner.

Q By whom are you employed?

A The University of Michigan.

Q What is your position with the University

of Michigan?

A I am associate professor of electrical engineering.

Q For how long have you been associate professor of electrical engineering at the University of Michigan?

A I have been associate professor for two years, and I was an assistant professor for four years before that.

Q For four years?

A For four years, yes.

Q And prior to that were you with the University of Michigan?

A Yes, I was.

Q In what capacity?

A I was a research engineer.

Q For how long were you a research engineer at the University of Michigan?

A I was a research engineer from 1961 until 1969, at which time I joined the faculty.

Q Prior to 1961, were you with the University of Michigan?

A I was a student and a part-time research engineer and associate research engineer from the fall of '61, beginning of the fall of '61.

Q Prior to the fall of '61, what was your association?

A Let's see, I worked at Lear, Incorporated. I was a research -- excuse me -- design engineer at Lear, now called Lear-Siegler, Grand Rapids, Michigan.

Q For how long were you a design engineer at Lear, Incorporated?

A Let's see, I joined them in February of 1960, and then I left in September of '60 to go to the University

of Michigan, and I guess from the fall of '60 to '61, I was a graduate student, and part-time research engineer, research assistant.

Q At Lear?

A No, I'm sorry, at Michigan.

Q Have you had any other association with Lear, Incorporated, other than that period when you were design engineer in 1960?

A Yes, I have been a consultant to the Lear Engineering Management for the past two and a half years.

Q Will you briefly describe your activities and responsibilities as associate professor or assistant professor of electrical engineering at Michigan?

A Yes, I spend a portion of my time in academic work, teaching. I teach an undergraduate course and a graduate course. The undergraduate course is instrumentation, electronic instrumentation and measurement. The other portion of my time is devoted to research -- excuse me, I meant to describe the graduate course -- the graduate course is electro optics, fundamentals of electro optics.

The other portion of my activity at Michigan, roughly 60 percent of my time, is devoted to research in instrumentation and electro optics.

I am currently the director of the Vehicular

Electronics Laboratory at the University of Michigan.

Q How did your duties differ, if at all, prior to the time that you became assistant professor of electrical engineering at Michigan?

A Before the fall of '69, I was essentially a full-time research engineer, and during that period specialized in electro optics, and some portion of my activity was also devoted to instrumentation.

Q Can you describe your activities as a consultant to Lear over the last two and a half years?

A Yes, we -- Lear is one of the major manufacturers of aircraft electronic instrumentation for navigation, some for weapon delivery, and the like -- and have been a consultant, technical consultant, to management system design problems, and, in some cases, market analysis. I don't mean in the sense of whether the market exists, but in terms of the technical feasibility of certain proposed instruments for a given marketplace.

So, it was a technical advisory capacity.

Q Have you acted as a consultant to any other company other than Lear, Incorporated?

A Yes, I have. Just recently I have been a consultant with Bendix Research Labs in Southville, Michigan.

Q In general what have your responsibilities and duties in respect to your consulting to Bendix?

A I have been working with a group at Bendix which has the title "Sensors and Actuators," and I have been responsible for reviewing their sensor design programs and also have helped to design an instrument for measuring mass air flow into an internal combustion engine.

Q Have you done consulting to other companies?

A Yes, I have.

Q Will you briefly name some of those and the type of work?

A Kelsey-Hayes, also in Michigan.

Whirlpool Corporation, in Benton Harbor.

Gleason Works of New York State.

There have been others. It is difficult for me to remember all of them without looking over the resume. I have trouble even when I write out a resume remembering.

Microdot.

And some smaller organizations.

Q Have you had any experiences in the fields of radio or television?

A Yes. Beginning at the time I was in high school, I built radio receivers and did some repair of

television receivers, beginning when I was a junior and senior in high school.

Q What is your general level of familiarity with television circuitry, would you say?

A I understand the concept of television. I understand the circuitry, and I understand television as a communications system.

Q Have you had any patent applications filed in your name?

A Yes, I have. There was a patent applied for with Whirlpool on an automatic water level control for washing machines, and with Kelsey-Hayes for an instrument for measuring the surface characteristics of certain brake shoe designs.

Q Have you had any articles or publications published under your authorship?

A Yes, I have. In my resume there is a list of technical articles which I have published.

MR. ANDERSON: Your Honor, rather than to have Dr. Ribbens go through that list, I will hand up Plaintiff's Exhibit 95, which does include a list of publications.

BY MR. ANDERSON:

Q Dr. Ribbens, would you please describe your formal academic training after high school?

A I completed a Bachelor's degree in electrical engineering at the University of Michigan, and that was in January of 1960.

I completed a Master's degree in electrical engineering in June of 1961.

Then I completed the PhD, also at the University of Michigan, in the summer of 1965.

Q In that academic training did you have within the EE discipline any specializations?

A At the time my specializations were in microwave. My graduate work was in microwave instrumentation.

THE COURT: I notice, Dr. Ribbens, that some of your publications are confidential. What is the purpose of that?

THE WITNESS: Those were technical reports which were issued as an output or result of some research we did for the Government, for the Army. I think they tend to overclassify. Some of that literature is in the open literature. Some of the results are in the open literature.

BY MR. ANDERSON:

Q Dr. Ribbens, what have you done to prepare for your testimony in this litigation?

A I have studied the patents in suit. I have studied schematics of the accused games, and I have looked physically at some of the accused games. I have studied some of the prior art.

Q Have you performed any tests on games?

A Yes, I have.

MR. GOLDENBERG: Your Honor, at this time I would ask the Court for a ruling as to whether Dr. Ribbens is qualified to give expert testimony in this case. He has recited his experience. The sole connection with television has been to repair television sets as a high school student. He doesn't teach any courses in it. None of his consulting work is in connection with television receivers. There has been no evidence that he has ever had any experience in the design of display devices, and the use of digital techniques.

Now, I understand that this is a matter for the Court's discretion. I would call to the Court's attention two decisions. The first is Ward v. Hobart Manufacturing, at 450 F. 2d 1176, where the

issue before the Court was negligence in the design of a meat grinder.

On page 1183 the Court of Appeals said this:

"Although Dr. Carley has impressive credentials in the field of mechanical engineering, he has had almost no experience in the design of any type of machinery and no experience in the design of meat grinders. He had done no research in the design of meat grinders in 1948."

In preparing to testify, Dr. Carley had looked at current Hobart brochures and made a cursory examination of some Pennsylvania and Ohio safety regulations.

The Court said that testimony by that kind of witness was not satisfactory in that case.

I also would like to quote from --

THE COURT: Had the Court received it there or excluded it?

MR. GOLDENBERG: The Court reversed on the basis that that was the only testimony.

In a patent case, and this is Forbro Design Corporation v. Raytheon, and this is the First Circuit in 1976, and with apologies, the only

citation I have at this moment is a U.S.P.Q. citation, 190 U.S.P.Q. 49.

The issue before the Court were voltage regulators and their patentability.

The Court received the testimony, and the Court of Appeals acknowledges that the expert testimony should have been received. But it did say this, and this is one page 53:

"The trial Court has wide discretion in determining whether a purported expert is sufficiently qualified to take the stand and render an opinion in a certain area," and it cites a Supreme Court decision.

"To be sure, there are limits to discretion, and a person lacking qualifications in the pertinent art or some other basis for testifying as to what would or would not have been known by one of ordinary skill in the pertinent art should not be allowed to express an opinion."

In that case the Court found that that witness qualified and received the testimony.

I think after two and a half days of trial, we know the technology and the art with which we are dealing. I have heard nothing in the witness'

testimony which qualifies him in the art with which we are dealing or any related art.

THE COURT: I would like to hear more foundation testimony from the witness as to the relationship between the field of electronic instrumentation and the field of electronic optics and the relationship of those fields to the electronic circuitry that is involved in this case.

I notice in the Ward case, the Court said that the witness had no experience in the design of machinery. I don't know but that what we are dealing with here isn't electronic instrumentation. Let's find out.

MR. ANDERSON: Your Honor, I would merely comment that under the new Federal Rules of Evidence, of course, the latitude on receiving expert testimony is very broad, the test being if it will be helpful to the Court.

THE COURT: I understand.

MR. ANDERSON: I just really make that as an aside, not as an argument.

But certainly I will ask Dr. Ribbens several questions in response to your query and suggestion, but certainly we are putting Dr. Ribben forward as an expert in the field of electrical engineering, in the field of electronic circuit design, all of which is very relevant here.

THE COURT: Well, let's find out more about that. I don't know what electronic instrumentation is. It sounds to me like it may include electronic circuitry. I don't know. Let's find out.

THE WITNESS: Yes, your Honor --

BY MR. ANDERSON:

Q Dr. Ribbens, will you respond?

A Yes. Excuse me for being imprecise.

Instrumentation is that collection of apparatus necessary to control, communicate or to measure, and television is a form of communication systems, and, in fact, in a way, is a special case of instrumentation. Many of the issues and the principles and the concepts of television have been understood for a sufficiently long time so that they are not given special emphasis in current academic study. We use them by way of illustration of principles we believe that are more abstract -- excuse me -- are on a larger abstract plane than television itself.

So, to have someone specializing just in the study of television would be unfair to our students today. So, we use it as an example.

THE COURT: Do you, in your courses that you teach in electronic instrumentation, then, teach, oh, specific matters having to do with television?

THE WITNESS: Yes.

THE COURT: And then what is electro optics?

THE WITNESS: Yes, that's the science of all materials and devices in which there is a direct

interaction of electricity and light, and, of course, one of the best examples of that I can think of is the television tube, which I hope I can get to, if I can testify.

So, it's an electro optic device. There are many others such as electro transducers, which receive light and generate an electric signal in response to that.

THE COURT: The Court will overrule the objection.

BY MR. ANDERSON:

Q Just as a further explication, Dr. Ribbens, have you had any involvement in electronic circuit design, as such?

A Yes, I have.

Q The design of circuitry?

A Yes.

Q In general, in the various areas where you have described, where have you been involved in the design of electronic circuits for what you described?

A Once again, I began designing circuits in high school, and that continued through my academic career as an avocation, and then I first began designing for a career when I worked with Lear. In those days, the majority was in terms of discrete circuits. I

think the issue of discrete and integrated circuits has already been raised.

I have done some circuit design both on a low frequency basis while I have been at the University of Michigan and also in terms of microwave circuits, and recently the group -- the research group with which I have been associated, and which I have directed, has developed a number of, if you will, circuit components for optical circuits. In fact, we pioneered the develop--ment of an optical circulator.

Q Thank you. Now, I had just asked you what you had done to prepare specifically for participation in this litigation. Will you please state what you have done in preparation --

THE COURT: He has already answered that.

THE WITNESS: I thought I did.

MR. ANDERSON: All right.

Q Can you explain how a game device as taught in the patents in suit is used with a television set, and, in particular, related to the signals involved?

A Yes, I believe I can. I think it would be helpful, however, to begin with a brief review of some of the principles involved in television, television receivers.

MR. ANDERSON: Your Honor, if it's acceptable to the Court, I will have Dr. Ribbens go through a series of charts which he has prepared on really the fundamentals of television.

THE COURT: I'm sure I would find it helpful.

MR. ANDERSON: I thought when we first suggested this that perhaps it would be in almost a vacuum. You have now had quite a bit of background. I would suggest that you interrupt if at any point it becomes redundant with what you have already had from other witnesses.

BY MR. ANDERSON:

Q Dr. Ribbens, will you proceed, then, to explain how the television picture is generated and displayed in the television receiver?

A Yes. May I come down?

THE COURT: Do you have a set of these?

MR. GOLDENBERG: Yes, we do.

THE WITNESS: May I come down?

MR. ANDERSON: Yes, please.

BY THE WITNESS:

A I will begin with an exhibit which I think has already been shown to you in Mr. Anderson's opening statement, Exhibit 79, and I would like to, first of all, just review on a relatively low level the concept --

THE COURT: That's the level where I find myself!

BY THE WITNESS:

A I think the way I would like to view it is television is a form of communication system in which two-dimensional images are sent from one point, which we will call a transmitter, to another point, which we will call a receiver, and in the television systems which we use in the home, they are sent from a commercial broadcast station to a broadcast television receiver.

A television has to be capable of sending,

over a distance, a two-dimensional image, and must be capable of simulating motion. I think the background most of us have with simulated motion being produced from essentially static images is from the motion picture concept, and in the motion picture concept we take a number of static, fixed, two-dimensional images, and display them on a screen in rapid succession, and if the number of static images occurs at a great enough rate in an interval of time, the eye perceives those as simulating continuous motion.

Television operates on a gross conceptual scale pretty much the same way. In the motion picture industry, I believe they use 24 frames per second. In television, we used 30 complete pictures a second.

There is an additional difference between displaying motion pictures and television. In motion pictures we have the capability of simultaneously sending a two-dimensional image through space onto a screen through a distance, and, in principle, we could imagine taking a similar picture for television and sending it through space simultaneously, that is, all of the picture elements, but, in practice, that would involve such an expensive communication system, that it wouldn't be commercially successful.

So, there's another aspect of television which makes it possible to use existing communication links, and in a communication link there's a connection between a transmitter and receiver in which a signal varies with time, and in television, we vary -- we transmit an electric voltage which varies with time, but it's a signal -- if you can think of that signal as being a one-dimensional signal, we are trying to represent a two-dimensional image with a one-dimensional signal.

The concept which made possible the use of commercially acceptable -- that is, cost effective -- communication systems is the concept of display repetitive images is scanning.

I believe Mr. Anderson introduced, in a simplified way, the notion of scanning, by using Exhibit 79. In this exhibit, we imagine sending, if you will, a continuous strip, and I believe Mr. Anderson removed the strips on this display panel and arranged them in a continuous linear fashion so we could have one slice through this picture at a time. You can imagine the analogy -- the analogy we have used is to imagine this continuous strip is passed through an opening in the wall, and there's a person on the other side receiving that, and every time he comes to a red marker, he slices

the strip and places it on his display panel. He continues until he comes to a process which has a blue marker on it. The information he has from that is that that's the end of one picture.

You can imagine repeating this process a number of times. Each time, we may have a representative two-dimensional image which is changing, and if we could repeat this process fast enough, then we could simulate motion.

We also would be utilizing a one-dimensional communication channel. That one-dimensional communication channel can be thought of as if we move along the strip, whether the color is white or black along that strip. Television uses essentially that same principle called scanning, except there are a great many more picture slices, called lines, in television, and they come at a much greater rate than we are able to imagine manipulating manually. It's through the tremendous speed of electronic instruments that it's possible to do this.

Well, the essential features to keep in mind for understanding the concept of television is the representation of an image by slicing it, and also keep in mind that we need to identify the end of each strip, and on this Exhibit 79 we have indicated the end of each

strip by a red marker.

Later on I will show that there are electrical signals which are sent along with the picture information which identify the ends of a line and tell the television receiver when it's to begin the next line.

So, scanning is a principle that's important, and also the information at the end of each line, and finally at the bottom of each picture is important.

With that, I would like to consider --

Q Would you take the next chart, then?

A Yes.

Q Would there be any benefit in transferring this over to this easel?

A Yes, we may, although I think at the moment -- I'm placing Exhibit 80 on the easel.

Exhibit 80 is a schematic illustration of the device which appears in a television receiver, and particularly this device is called a television picture tube. It's a member of a generic class of vacuum tubes called cathode ray tubes.

At the extreme right edge at a region where there's some lines drawn, this represents the face of the television picture tube, and is the portion which is viewed by the observer.

The portion to the left, the so-called neck, extends back into the cabinet and is not seen by the viewer, because there is cabinetry built all around this.

In addition to the screen, this what you would call the portion with lines drawn on Exhibit 80, the screen of this television picture tube, there are a number of other elements which are important.

I direct your attention to the left portion of this schematic, this representation, to a component which is called an electron gun. This functions to produce a stream of electrons which are moving generally in the direction of the screen.

Now, these electrons come out with random velocities and in random orientations. It is important for representing television pictures and for the scanning process, in having high resolution, to keep the point of impingement of this beam of electrons on the face of the screen as small as possible.

That can be done by a device and apparatus which focues in a way analogous to focusing a light, on the face of the screen.

This is done with a magnetic coil, and it happens that the motion of electrons is influenced by a magnetic field. So by properly positioning and by properly winding a coil and passing a proper current through it, we can cause the beam of electrons which leaves the electrons then to fall to essentially a focused spot on the screen.

Now, the benefit of that, from the viewer's standpoint, is that a beam of electrons falling on a screen generates light. It does so because the screen is coated on the inside with a chemical phosphor, and that has the property of generating light in response to a beam of energetic electrons, essentially shooting a beam of electrons up to the screen.

This is one aspect of this electron optic device, if you will, in which a beam of electrons produces light.

The intensity of the light or roughly speaking its brightness is determined by the strength of the beam of electrons, which we can control electrically.

Now, for simplicity, your Honor, I would like to discuss essentially just black and white television, because I think color adds an unnecessary complication for understanding the point.

So with your indulgence, I will discuss only black and white television.

The other elements of the television picture tube which are important for its use in displaying television pictures are the so-called vertical and horizontal deflection coils. These are a pair of coils through which a current can be passed, and the

result of passing a current through a coil, analogous to the focusing coil, is to produce a magnetic field.

The magnetic field interacts with a beam of electrons and causes the beam to be deflected, so that we can sweep, if you will, the beam of electrons back and forth across the screen.

One pair of coils causes the beam to move vertically; another pair of coils causes the beam to move horizontally.

As I will explain presently, the television set generates the currents which are sent to these deflection coils, and there is a specific characteristic current distribution. That is the current has to vary with time in a particular manner to cause the beam to move so that we can display a picture.

Ideally, what we would like to be able to do is to cause the beam to sweep across the face of the tube continuously from left to right, and it is moving from top to bottom.

Well, I think I need to perhaps just summarize this. I have another chart that I would like to present in talking about the way in which the beam is moved across the face of the tube. However, just in summary, we can realize that we generate a stream of electrons, focus them to a spot, that they can be deflected by currents flowing through coils, and we can also control the brightness of the spot at any point by controlling the strength of the beam of electrons, the number of electrons, if you will, in a given interval of time. We can control that by means of an electrical signal source, which on Exhibit 80 is called a Video Signal Source.

So this will be our primary means of controlling the strength of the electron beam and therefore controlling the intensity of the light at any spot.

I would like now to move on to another chart, in which I talk about the characteristic way in which the beam is swept across the face of the television picture tubes that we can represent pictures.

BY MR. ANDERSON:

Q Dr. Ribbens, would that beam be considered analogous to a stream of water coming out of a garden hose, or something like that?

A I guess it could, yes.

Q To show the way it would travel?

A With the exception that water coming from a nozzle is diverging, and that wouldn't have the focusing aspect typically, but yes, in general, roughly speaking, that would be analogous.

Q Go on to your next chart, please.

A We have a chart labeled Exhibit 81, which I think just shows a little bit more schematically that there are one pair of coils which causes the beam to move vertically and another pair of coils which causes it to move horizontally, and they tend to act independently.

Now I am putting Exhibit 82 on the easel.

If we are going to display a television picture which has coherence, it will have been originated at the television transmitter. The picture will have been dissected by scanning at the television transmitter, and we wish to reconstruct it on the television receiver screen in the same manner and in syncronism with the scanning, so that the scanning that is done at the transmitter and the receiver must be done together.

Otherwise we will lose coherence of the picture, and we won't be able to reconstruct the image that we are attempting to reconstruct.

So there is a systematic pattern for scanning the beam across the face of the television picture tubes.

The standards for this were agreed upon a number of years ago.

Beginning at the upper left portion of the face of the television picture tube, the beam scans at a uniform speed from left to right until it reaches the right edge of the face of the television picture tube. Then the beam is caused to disappear. It is shut off by means of the Video Amplifier, the Video Signal Source, that can turn the beam off, and it is caused to move from right to left very rapidly. That motion is called retrace.

I think it is indicative of the fact that we are not displaying a picture during the movement from right to left in a properly adjusted television set. In an improperly adjusted television set you may have seen in the past some faint lines across the screen. Those were retrace lines where the beam wasn't completely shut off. So the beam itself is not present during the retrace, but the equivalent position of the beam,

if it were there, is indicated by the dashed line in Exhibit 82.

Once it reaches the other side, the beam equivalent position, if you will, is caused to trace from left to right again along the solid line. This practice is continued. That is, we scan at a uniform speed, we retrace at a much higher speed, turn the beam off during retrace.

Now, during the scanner we vary the intensity of the light in accordance with the signal which has come from the transmitter. The transmitter is looking at a scene, measuring the intensity of the light in that scene, scanning the image of that scene, and generating a signal in proportion to that brightness, and then transmitting that to the broadcast television receiver.

THE COURT: Does the transmitter transmit, then, one line at a time?

THE WITNESS: Yes.

THE COURT: Or does it transmit the whole picture?

THE WITNESS: One line at a time.

THE COURT: So really the TV set continues the same one-line process that the transmitter began.

THE WITNESS: That's correct.

BY THE WITNESS:

A Now, there are two things that help your eye to perceive this as a continuous static image. One is the persistence of the screen, that even after the beam is moved off, there is an interval of time that light is still being produced. But more important than that is the finite perception of the eye. This is what makes motion pictures able to simulate motion, because the eye perceives rapidly-presented scenes as a continuous motion.

Of course, if this were all done at a very slow rate, you would see an image that flickers. In the old days motion pictures were called flicks, because the intensity flicked because it was presented at too slow a rate.

This process can be imagined to continue for the full dimension of the television picture tube

until it reaches the bottom, and then the beam has to be deflected back to the top, so that in addition to the horizontal retrace, when the beam has reached the lower right portion of the face, it is brought back to the upper left with the beam turned off, and this is indicated at the lower portion of Exhibit 82 by the dashed line on this simulated face of a television picture tube.

It is called vertical retrace.

Keep in mind that the vertical motion during the construction of the picture is very much slower than the vertical motion of the beam's position during the retrace and that the beam is shut off.

BY MR. ANDERSON:

Q Dr. Ribbens, I notice that it is a rather unusual shape that you have marked "vertical retrace". Does the beam actually follow a path like that, or does it go directly from the lower right to the upper left?

A Because of the physics of the device, it is necessary to continue this horizontal motion. We don't want to stop the horizontal motion. So depending on the interval of time it takes for the retrace, there is a continuous horizontal motion, but it is timed in such a way that by the time the beam is at the top, it is prepared to move from left to right.

Another important aspect of television that keeps the display coherent with the camera at the television transmitter are what we call synchronizing information. This is analogous to Exhibit 79, in which we kept track pf the picture source and receiver by putting red marks at the left edge. Now, the television transmitter doesn't place any kind of color coded marks, of course. All it can transmit are voltage levels.

So the television transmitter sends voltage levels which have a specific characteristic graph or waveform which I will get to presently.

The television receiver interprets those voltage changes to say, "This is the end of a line, and now it is time for me to retrace, move back and start over again."

So all the television transmitter has to do is to identify the end of the line; the retrace and the beginning of the next scan is automatic and goes on in the television set.

Finally, when we get to the bottom of the picture, we have to identify that the bottom of the picture has occurred, so we transmit a different piece of voltage information, which I will identify in more detail presently, which tells the television set to tune off the beam

and to cause the retrace back to the upper left.

Those are the essential pieces of information.

So it is transmitting a voltage which controls the instantaneous brightness of the picture being generated by controlling the strength of the electron beam. It also transmits information which tells the television receiver to retrace, both in horizontal motion and in vertical motion.

Q And that information is called synchronization information, is it?

A Yes, and I was about to display that in a graphical way in the next exhibit, if I may.

Q Before you go to the next chart, Dr. Ribbens, we have a television set, Exhibit 6, sitting over there, and Mr. Williams has removed the back cover. Perhaps you can point out physically in a television set where the various parts you have just described are located.

A We have the focusing coil and the deflection coils which are located on the neck. This is the neck of the tube. Of course, the phosphor is on the inside face. The electron gun is located right in here. This is the focusing coil.

(There was a brief interruption, after which the following further proceedings were had herein:)

THE WITNESS: I was identifying the electron gun, the focusing coil and the horizontal and vertical deflection coils.

BY THE WITNESS:

A So the beam is being sent up here. It was no small step in television art to be able to prepare the dimensions. to have a short neck. It is much easier to control electrically the position of the beam if you had a very long neck, and it was quite a development in television art to be able to shrink the neck of the tube up so we could make a smaller physical package for the television receiver.

This is the tuning portion right here.

THE COURT: Where is the part on your diagram that is marked as the video signal source?

THE WITNESS: That would be in the television receiver (indicating). This is part of the circuitry that works with the tuner to select an individual station. It would be an intermediate amplifier, and the actual details I don't have a schematic on in front of me, and I would need one to identify where the video source is. But it would be connected to one of the terminals at the back of the picture tube. This would be the back of the picture tube here.

So I would have a voltage that varied on one of those terminals which controls the current being emitted by this electron beam.

This is the high voltage lead, which helps to accelerate the electrons toward the face of the screen.

THE COURT: What is it that the cathode ray tube adds to this process? I have heard what the phosphor does, but why do you use a tube of this kind?

THE WITNESS: You mean why is it enclosed?

THE COURT: Why don't you just have a regular piece of glass with some phosphor painted on?

THE WITNESS: Out in space?

THE COURT: On the inside.

THE WITNESS: I have glossed over a number of important physical details.

First of all, it had to be a vacuum tube, because if there were any gas, such as air, in the tube, then the path of the electrons would be badly influenced by that gas. You would never really effectively get the beam up to the face. So the reason it is in a tube is so that you can provide a vacuum environment that way.

BY MR. ANDERSON:

Q Dr. Ribbens, why is a television tube a cathode ray tube? In other words, what is it about a cathode ray tube that makes it a cathode ray tube?

A The cathode is the emitting source in this device.

Q Perhaps you can refer to Plaintiff's Exhibit 80, the chart, and explain what it is that makes a given device a cathode ray tube, if that is the Court's inquiry.

THE COURT: Yes, really it is. I realize how elementary that is, but I don't even know that much.

BY THE WITNESS:

A Cathode is an element in the electron gun which emits the electrons. There are a number of other elements in the electron gun, to which voltages are applied, which accelerate the electrons. It is important to keep the path of flight of the electrons small so you won't have a large delay between the response on the screen and the signal being produced here. We like to keep that time short.

THE COURT: The catnode ray, then, is what is emitted by the electron gun?

THE WITNESS: That's correct. It goes back a long time, to I think the beginning of the century, in which there were a number of vacuum tubes which emitted a beam of electrons such as this, and which is called -- it is a generic term for a variety of tubes.

There are some other applications for this type of structure, other than those we have mentioned.

Now I have lost track of where I was. I think I have completed my remarks with regard to Exhibit 82, and I think I wanted to illustrate this one in dimensional waveform, which is being sent from the transformer to the screen, which is called a video signal.

BY THE WITNESS:

A This is a time varying voltage, and because we are able to cause the beam to move in a predictable manner with respect to time and can trace out a distance along the face of the tube with respect to the time, we can control the position of various elements in the picture by time.

So I think I can illustrate this characteristic of television by the next exhibit, in which I have graphically represented the voltage, which varies with time over our communication channel, which we have called the video signal.

This is a schematic graph, quanitative graph, not a precise graph, in which the ordinate is the so-called video signal, which represents a voltage amplitude.

Q What is the exhibit number?

A Exhibit 83. I thought I had mentioned it.

The abscessa is time. And -- let's see. On this graph perhaps you will notice that we have colored various portions of this graph to make it easier to refer to them.

The red portions, which we have labeled "Horizontal Synchronizing Pulses," are analogous to the red marks on Exhibit 79. These tell the television set that it is the end of a line and it is time to do the next line.

The blue portion, which is labeled "Vertical Synchronizing Pulse", corresponds to an interval of time and you will note that the characteristic graph for the vertical synchronizing pulse is different from the horizontal synchronizing pulse, and that difference is important in order to enable the television receiver to identify the difference between horizontal synchronizing information and vertical synchronizing information.

Q When you say the horizontal sync is different graphically than the vertical, is it possible to state in what way and just in general why that is functionally important?

A Yes. These are very short duration (indicating).

These exist for just a short period of time. That is, the horizontal synchronizing pulses do.

The vertical synchronizing pulses are essentially a block of pulses which are interrupted. You can think of this as being a continuous pulse which is interrupted, and the spacing between the interruptions is twice the rate of the synchronizing pulses.

Now, there are some details. I am skipping over a great number of details in actual television practice called interlacing and the detail of this structure of pulses I think is unimportant to the main concept. But I think the important concept here is to think in terms of, first of all, the red pulses and the blue pulses, which are voltage levels, which give information to the television receiver when it is to begin retracing horizontally and vertically, and the yellow line, which is information which controls the video signal source, the video signal generator, referring back to Exhibit 80, the yellow-colored coded block, which is called the Video Signal Source.

The varying voltage here controls the strength of the electron beam. So if you can think of a voltage which is varying with time, between each of the red marks on this Exhibit 83 is a moving yellow line.

We are just attempting to represent in that yellow line a time varying voltage which will control the strength of the electron beam in our television picture tube and trace out whether it is light or dark, white or black, or in between.

Now, in the video signal it may seem a little odd, but they chose to represent increasing voltage as representing the black level. As the voltage increases between these red marks, as we increase the voltage, we are tending to turn the electron beam off and make the picture black. As the voltage decreases, we are tending to make the picture white.

THE COURT: Is that literally what happens?

THE WITNESS: That is literally what happens. In fact, the picture will be completely off at a level which is indicated by the horizontal line, just at the bottom of the synchronizing pulses.

So the picture will be completely turned off here.

This if often called the blanking level, because the picture is blanked or turned off.

Black also corresponds to a level in that region, depending on the adjustment of the television receiver.

THE COURT: If the electrons light up the screen, I don't understand why the stronger the horizontal pulse, the darker the screen.

THE WITNESS: The greater the voltage the less the current. As I increase the voltage here, I am suppressing the current, reducing the current. As I reduce the current, I make the screen blacker.

THE COURT: You increase the voltage in order to reduce the current?

THE WITNESS: Right. That is why I say it seems perverse. But there was a good technical reason for choosing that convention years ago.

BY MR. ANDERSON:

Q Dr. Ribbens, could you analogize the voltage that is actually controlling the current as like a voltage closing a gate, or something, so that the bigger the voltage the more the gate is closed? Would that be appropriate?

A That sounds like a reasonable analogy. I hadn't thought of that.

As I increase this voltage, I am tending to shut that stream of electrons off.

Q Would it be possible to relate your voltage time diagram, Plaintiff's Exhibit 83, to the schematic television picture, Plaintiff's Exhibit 79, to clarify the time voltage relatinnship?

A Yes. Thank you.

The interval of time between the left and the right edge of one of these strips corresponds to the time interval between adjacent red marks, adjacent synchronizing pulses. So if you imagine time as running continuously across the strip, the white level on the top would correspond to the lowest voltage level. That is, the voltage level on Exhibit 83 during a trace corresponding to the top strip would stay near the bottom, near zero.

On the next strip you can see that it's mostly white until you get to nearly the central portion, and then it's black. That would correspond to a voltage level near zero, until I get to a position where it's black. The voltage would jump up, stay black for an interval of time corresponding to this distance, drop back to white again -- or drop down to near zero again, and continue until it reached the next synchronizing pulse.

Now, there's another aspect. This is not drawn to scale. There are a great many lines. In commercial television in this country, there are some 500 lines. The standard is 525, of which close to 500 are actually displayed.

THE COURT: Refresh my recollection. Are those lines actual physical components of the face of the tube?

THE WITNESS: No, they are equivalent positions of the beam.

THE COURT: Equivalent positions?

THE WITNESS: Right.

THE COURT: All right.

BY THE WITNESS:

A The actual line is determined, and its position is determined, by these deflection coils.

All right, as I said before, we have greatly compressed this to illustrate what I think are the important concepts of television, that is, of time varying voltage, which has the ability to control the strength of light being emitted from any point on the screen, both the horizontal and vertical synchronizing voltage, which gave information to the television receiver when to start and retrace the next line.

In addition, the position of the beam

is determined in the television receiver itself. We are only starting each new line with these pulses. We are starting each new picture element with -- that is, each complete frame.

I should qualify this by making the observation that in television they don't transmit the whole picture at once. They transmit half the picture in a sixtieth of a second, and the other half in another sixtieth of a second, and the two are superimposed and meshed so that they fall adjacent to one another and are so-called interlaced.

But the details of that are also beyond what we need to understand in concept.

So, for all practical purposes in our discussion, we can think of all of the lines that make up a picture as extending from the edge of the blue pulse, and then, as time continues, we have a number of pulses which keep the beam tracing from left to right. Finally, at the left edge I would come to the first actual displayed line, and this is where I begin displaying video information, and there would be a number of lines,in fact 262 1/2 in broadcast television. The 262 1/2 line would come over here (indicating). Then I have completed a picture.

Then this voltage level is indicated

by the horizontal line at the base of the synchronizing pulses as a blanking level. The beam is turned off at this level. Then the synchronizing pulse tells the beam to top, retrace vertically, and begin again.

Q Dr. Ribbens, can you show how this waveform is related to TV games?

A Yes. We have prepared Exhibit 84, which gives, in a very schematic way, a similar waveform, but I have suppressed a great deal of the information. I haven't shown the vertical synchronizing pulse as it stands, but I have shown the individual horizontal synchronizing pulses. This is Exhibit 84.

Q Perhaps before you start that chart, I would like to ask you, with respect to your testimony so far relating to the basic TV component and the waveforms and the picture that's produced, was all of that known prior to, say, 1960 or '65?

A The technology for displaying the picture?

Q Yes.

A Yes, yes.

Q So that you are explaining the state of TV technology, basically?

A Yes, right.

Q All right, then, go ahead now and, if you will, relate that to the TV games and the way in which TV games are displayed.

A All right. I will begin with a more schematic approach, perhaps.

In Exhibit 84 I have a similar graph of

a video signal in which the ordinate is represented by a voltage level video signal, and the passage of time.

Schematically, I have indicated at the left-most edge of this waveform the time of occurrence of the vertical synchronizing pulse.

So, following this vertical retrace takes place, and we move to the upper left portion of the screen. What I am attempting to represent in this exhibit is depicted at the lower edge of Exhibit 84, and this is a schematic representation of the display on the television screen of a white background with a black rectangular dot.

So, I would like to describe a video waveform which is capable of displaying such a symbol. Once again, this is very schematic, but following the top of the --

THE COURT: Excuse me just a minute.

THE WITNESS: I'm sorry.

THE COURT: So far, we have been talking about a black screen with a white dot.

THE WITNESS: Yes.

THE COURT: Does this make any difference?

THE WITNESS: I have another exhibit which I can show that will illustrate a white symbol on

a black background. The white form looks slightly simpler, perhaps.

THE COURT: All right, I might as well become versatile.

THE WITNESS: I could skip this and get on to that and save time.

THE COURT: Well, why don't you go on to the one with -- since all these games do seem to involve a black screen with white dot -- is that correct?

MR. ANDERSON: As far as I know, that's true.

Mr. Goldenberg?

MR. GOLDENBERG: I'm sorry, my attention was --

MR. ANDERSON: I think all of the games involved in this lawsuit involve white spots representing paddles or balls on a black field, and not the converse.

MR. GOLDENBERG: That's true.

THE COURT: I think that might be more helpful to me to go directly to that one.

MR. ANDERSON: Thank you, your Honor.

BY THEWITNESS:

A All right, I will remove Exhibit 84 and put Exhibit 85 on the easel.

Yes, at the lower edge of Exhibit 85, we

have graphically represented the image that would be displayed on the face of the television picture tube, which is a black background with a white rectangular dot, and the upper portion of Exhibit 85 is the voltage waveform video signal being proportional to voltage, and then timing.

The left edge of this graph corresponds to the instants at which vertical sync takes place. The beam is retraced to the upper left portion. After some time, a number of horizontal synchronizing pulses will have occurred. I will come to one following which I will display the first picture element of the displayed symbol -- excuse me, I need to back up just a moment -- The red mark on this line above the horizontal line in the graph is labeled "Horizontal sync" and this corresponds to a voltage level which synchronizes the television receiver. I don't think I made this point before, but I think it's important to come back to it. These voltage levels are greater than the level necessary to produce black, that is, the beam turned completely off, so they don't produce a visible effect on the television set. The beam is already turned off. And the terminology is often used "blacker than black" for synchronizing pulses.

A line which would pass through the cross

hatch portion of the symbol depicted at the lower portion of 85 would be a line in which the synchronizing pulse is generated, and then the voltage remains at the black level.

So, for the entire trace, the voltage stays just at the black level, so that would correspond to a line through the shaded portion. No information.

Finally, I come to the first line in which there is a picture element, the white rectangle. Following the synchronizing pulse, the beam begins tracing. Remember, time on this graph corresponds to distance on the displayed television picture tube face. After an interval of time, the voltage level suddenly will drop down to a voltage level which corresponds to white. We have labeled that v_W. That would turn the electron beam on and trace across for the interval of time -- the interval of time we have labeled is t_W. So, for this length of time, the beam is turned off. That corresponds to the distance labeled X at the lower portion. For an interval of time labeled t_W the beam would move through a distance labeled W and the beam would be turned on, and then, finally, at the end of that interval, the beam would be turned back off by the voltage level returning to the blanking or black level.

And then the beam -- that portion of the display would correspond to the right-hand portion of the lower drawing.

In our relatively simplistic sketch we have only indicated four lines. These would be four lines in which picture information is displayed. These would correspond to four passes through this black -- or this white rectangle.

THE COURT: And you don't have to go lower than that in order to start over again, is that correct?

THE WITNESS: I'm sorry, don't have to --

THE COURT: In other words, you can get the beam off the screen without going all the way down?

THE WITNESS: Oh, no. In fact, thank you, that's a good question. I may not have said that very well.

This must continue for the full number of frames.

THE COURT: All the way down to the bottom right?

THE WITNESS: That's right. We have to trace the entire picture out each time. I skipped over that point, and I think this graph could be misleading in that sense. That's absolutely true.

THE COURT: Why is that, incidentally?

THE WITNESS: Well, it's important to keep the

vertical deflection and the horizontal deflection moving. We can't interrupt that motion. In fact, there are standards for which television sets are designed, and we must stay within those standards.

BY MR. ANDERSON:

Q And those standards are a time synchronous relationship between some of these phenomena?

A Yes.

Q Which ones?

A Ask the question again. You have lost me.

Q When you say there are standards to which television sets must be built, is that a standard of acceptance of certain relationships between the horizontal synchronization pulses and the vertical synchronization pulses?

A Yes.

Q Just briefly describe what that relationship is, then, that would create a standard for manufacturing television receivers?

A Well, I think, as I said before, there are 525 lines, and those are presented to the television receiver in two separate fields, 262½ in one field, and 262½ in the other.

I think if you convert that back to the time interval between horizontal synchronizing pulses,

it's of the order of sixty-some microseconds. The exact number, I can't remember. It's in the standard handbooks. It's of the order of 60 microseconds.

Q And that timed relationship of vertical and horizontal synchronization pulses is the essence of the standard that is established?

A Well, there are other standards, the details of which we haven't displayed, including the back porch and the front porch, and their time intervals, the duration of the horizontal synchronizing pulses -- there are a number of standards and pulses that have been suppressed in this detail because I don't think they are essential to an understanding of television.

Q Is that basically so that all receivers in the country can receive the transmissions from all transmitters, like having all garden hoses having the same coupling size?

A That's right. It's a standard so that all broadcast television receivers are capable of receiving all broadcast television information.

Q There's one other question I thought might be appropriate. Is there a scale between the time represented across one line in the upper half of Plaintiffs' Exhibit 85 and across here? Is that to scale, or --

A Yes, thank you, I didn't get to that point yet. That's what I intended to get to.

The interval of time from the horizontal synchronizing pulse to the beginning of the voltage waveform which displays white, that I am pointing to, I have labeled t_X, and because the beam moves at a constant speed, then time is proportional to the distance of the displayed image, so the distance labeled X at the lower portion of Exhibit 85 is proportional to the time t_X following the synchronizing pulse to the position of this leading edge, if you will -- and that's terminology which is used in these circles -- to the leading edge, which I have called t_X.

The time duration which the voltage states, labeled t_W is porportional to the width of the displayed spot labeled W.

Similarly, there's a timed relationship which determines the vertical position -- X being the horizontal position -- there's a timed relationship which determines the vertical position of this spot, and the vertical position, the top of this rectangle, at the lower portion of this Exhibit 85, is labeled Y.

Y is a space which is proportional to a timed interval which we have labeled t_Y on Exhibit 85.

So, t_Y is essentially a number of lines from the top of the picture. We allow a certain number of lines to go past.

The height of the displayed rectangle, which is labeled H on the lower portion of Exhibit 85 is proportional to a timed interval which is labeled t_H at the waveform depicted at the top of Exhibit 85.

You can think of it in terms of the position, the vertical position, as being determined by the number of lines which pass before we begin displaying information, the height of the symbol being proportional to the number of lines in which the symbol is displayed, and then the horizontal position being determined by the time interval following the synchronizing pulse and the beginning of the displayed symbol.

So, if I have a means of varying t_X and t_Y, I can move the displayed symbol around the screen, and we will get to that point later in our discussion when we describe circuits and devices capable of varying the time interval labeled t_X and the time interval we have labeled t_Y.

And, in fact, shortly, I think I can show that in a video game,one of the common video games -- in fact, a number of common video games. The Y position is determined by a knob which the player has at his control. I think on the Pong game, you may have noticed a pair of knobs. Later I think I can show that those knobs determine this time interval t_Y and, therefore, determine the position of Y.

Q All right, then, would you proceed with the next chart?

A Yes. The next chart is labeled Exhibit 86.

I call Exhibit 86, in the parlance, a block diagram of a television receiver and, in fact, particularly, a broadcast television receiver.

A block diagram is a schematic drawing on a level of abstraction which is higher than the schematic diagrams which include components and design of electric circuits. The components in a block diagram indicate functional operations.

I might direct your attention to the right-most portion ofthe display of Exhibit 86. We have schematically illustrated a figure which looks very much like a picture tube, and that's what we are intending to represent.

The yellow colored block is labeled "Video Amplifier" and perhaps you can recall in Exhibit 80 -- I believe it's 80 -- let's leave that one up -- I have identified a video signal source, and in the television receiver, we would call that the video amplifier, and it provides a signal along the yellow colored part which controls the strength of the beam of electrons which are directed at the face of the picture tube.

Q Now, while you are on that color scheme, I might place back on the easel Plaintiff's Exhibit 85, and is there a relationship in your color scheme of Plaintiff's Exhibit 85 to the block diagram, Exhibit 86?

A Yes, thank you.

Q And Exhibit 80?

A Right. In these exhibits, we have color coded the vertical deflection coils blue and the horizontal deflection coils red, and we have maintained that color coding scheme in our block diagrams.

The symbol which represents the television picture tube, the red colored portion, corresponds to the horizontal deflection coil, and the blue corresponds to the vertical deflection coil.

Q In the waveform charts that you have described, such as, say, Exhibit 83?

A Yes. Once again, the yellow is the video information, the red the horizontal synchronizing pulses, the blue vertical synchronizing pulses, so we have attempted to maintain the color coding for convenience and clarity, hopefully.

Well -- in fact, you just removed it -- I was just going to call attention to Exhibit 83, in which I represented what we have called a video signal. This is a time varying voltage. This would appear at a point on the block diagram just to the left of the video amplifier.

So, from this point on of the block diagram of the television receiver, we can identify the color coded yellow portion of the voltage and distinguish it from the red and the blue.

It's important to maintain synchronism. The synchronizing pulse's function is to maintain that.

They are effectively removed from the composite video signal by a device called the synchronizing signal separator. This is a combination of electrical components in a circuit which responds to the -- a voltage level greater than the blanking -- that is, the voltage level associated with horizontal and --

THE COURT: You have lost me on that last.

BY THE WITNESS:

A Well, the only thing we are interested in, in this lower portion of the block diagram of Exhibit 86, is the portion of the video waveform above the blanking level, because the synchronizing information is above this blanking level, and the lower portion of this block diagram is totally associated with causing the beam to trace in synchronism on the receiver with the transmitter.

So, this portion of the circuit only needs to identify the time of occurrence of the horizontal synchronizing pulses and vertical synchronizing pulses to cause the beam to deflect and generate the pattern.

I don't believe I gave it a name before, but I think it's been introduced earlier. The name given to the particular pattern in which the beam is

traced across the face of the tube is called a raster. I think that term has been introduced here.

BY MR. ANDERSON:

Q Well, Dr. Ribbens, is it necessary, then, in the television receiver, at the point that you indicated, where the complete video, I think, came into the video amplifier, is it necessary to have some sort of a separating device to separate out the various signal components that you have described?

A Well, with respect to the video amplifier, it isn't, because the voltage levels corresponding to the synchronizing pulses are blacker than black, and have turned the beam off.

Q So the complete signal in Plaintiffs' Exhibit 83 on would actually pass through the video amplifier?

A Yes -- well, it can, yes. However, we want the synchronizing circuitry, which causes the raster to be generated -- we need to respond just to the horizontal and the vertical synchronizing pulses, and we need to respond to them separately, because we want that motion to take place independently, but not independent of the transmitter.

They are separated from the synchronizing and sent in two separate channels. A block indicated on

Exhibit 86 called "Horizontal Sync" is a device which contains the horizontal synchronizing pulses. This responds only to the narrow pulses of this waveform.

A separate block just below it in Exhibit 86, color coded blue, is labeled "Vertical Sync." This block responds only to the portion labeled "Vertical Synchronizing Pulse" in Exhibit 83, the video waveform. And it's able to identify between a very short duration pulse and a long duration pulse with interruptions. And it happens that in one case we are differentiating a signal, in the other we are integrating the signal. We are responding to the rapidly changing leading edge in the horizontal, and responding to more or less the area under this curve or the interval of this function in the other case. So, it is possible to separate those two pieces of information.

Then, these drive circuitry which causes the current to flow through the horizontal and vertical deflection coils to cause the beam to sweep in a uniform manner and display the picture.

Those blocks are called the horizontal oscillator and horizontal deflection amplifier, the deflection amplifiers providing a current of such strength as to deflect the beam.

I think Mr. Baer alluded to the fact that in the old days television manufacturers used to provide controls at the back of the receiver which gave you some control over this circuitry. You could change the size of the displayed image by controlling components in the horizontal and vertical deflection circuits.

Q Now, there has been discussion, Dr. Ribbens, in the course of the proceedings, of sawtooth signals. Are there any sawtooth signals involved in the circuit that you have been describing in Plaintiff's Exhibit 86?

A Yes, thank you. The waveforms associated with the horizontal and vertical oscillator are waveforms which tend to vary linearly with time. By "linearly" I mean they want to produce a uniform sweeping rate, both horizontally and vertically, and if you were to prepare a graph of those voltage waveforms that tends to be isomorphic to the projected area of a --

Q Tend to be what, Doctor?

A I'm sorry, it looks very much like the teeth on a saw.

Q All right, now, can you, from this diagram, perhaps explain the relationship between these horizontal sync pulses which are very sharp, narrow pulses, and the sawtooth wave that you said is generated in the horizontal oscillator and horizontal deflection amplifier?

A Right. The horizontal synchronizing pulse determines the starting point for this sawtooth waveform, and from that point on the horizontal oscillator moves at a pace which is determined by its own circuit parameters. So you would design the television circuitry to cause this beam to move -- you would like to be able to trace a uniform path across the face of the tube to avoid distortion. Nonuniformities in the display, or nonuniformities in the beam, gives rise to distortion in the waveform.

But I think the point Mr. Anderson was trying to raise was in order to maintain synchronism with the television transmitter, we need to begin the horizontal oscillator sweep, and that is to begin the sawtooth waveform at the corresponding time as the television transmitter.

I don't know if I have made that very clear. Anyway, the function of the horizontal synchronizing pulse is to start the sawtooth waveform. I think perhaps I could have prepared another chart which would have been more illustrative. I apologize for that. But I think the essential concept that is important is that the deflection tends to be done automatically by circuitry in the receiver, but it's started by the transmitter, and the starting point which determines the beam at the left of the television and beginning its sweep is determined by the time of occurrence of the horizontal synchronizing pulse, and the time in which the beam begins its sweep from top to bottom is determined by the time of occurrence of the vertical synchronizing pulse.

So, it's these two times that are cri-- tically important to maintaining coherence between the displayed image on the television receiver and the picture which has been scanned at the television transmitter.

Q Does the vertical set of blocks that are blue in Exhibit 86 use a technique similar to the one you describe with the horizontal, namely, some sort of an internal sawtooth generator pulse?

A I tended to imply they were the same, except

they moved at different rates, of course; the horizontal oscillator is sweeping at a very much higher rate, because it has to go across the screen, and it has to do this 262 times for each one of the vertical oscillators, approximately.

THE COURT: All right.

THE WITNESS: I'm sorry. I may not have made that point very clear.

MR. ANDERSON: Yes, that's an answer to my question, Dr. Ribbens.

BY THE WITNESS:

A Okay. There are other components indicated on Exhibit 86 which we haven't color coded, which are part of a broadcast television receiver, and these are associated with the tuner, which enables you to change channels and select the desired channel, and I have indicated at the left a block, the symbol at the extreme left is the antenna symbol, so we receive the signal from the airways, they enter the television receiver, the broadcast television receiver, and go to a radio frequency tuner. This enables you to select individual channels, individual stations, because each station is transmitting on a different carrier frequency. These will be on the VHF or UHF bands.

Then there is a second stage necessary to amplify the signals to the appropriate level. Some will be fairly weak, so we may need amplification. That's in a block labeled "Intermediate Frequency Amplifier."

Then finally the video signal is removed from the carrier radio frequency signal by a block called the "Video Detector." So, the video detector removes the carrier and leaves us with a video signal as indicated in Exhibit 83. So, it's output is the point in the circuit at which we have been discussing waveforms.

THE COURT: What is intended by that line on

which you just had your finger that runs from the back of the video amplifier back around to the left side of the synchronizing signal separator?

THE WITNESS: Yes, I guess I didn't do a very good job of that. I'm sorry. All I'm trying to do is to say that we have all of the information in composite form, and so we need to connect the output of the video detector around to the device which separates the synchronizing signal.

So, I'm indicating that this same signal is presented at the input to the synchronizing signal separator.

BY MR. ANDERSON:

Q Now, is that signal the entire signal that's represented by Plaintiffs' Exhibit 83, Dr. Ribbens, that appears at this point? Perhaps we should label that point with some sort of a marker, because we have identified it so often. Could you run a lead line out from that and assign that a name that would be appropriate?

A I call it "Video Signal."

Q Composite. Would that be appropriate?

A Just in terms of the graph I have used. Composite video signal would be a better terminology. I was trying to be consistent.

Q You are taking the term video signal from Plaintiff's Exhibit 83 to show what is being applied at the input to the video amplifier, and at that point that you have just labeled video signal.

A And of course the same signal is available with the synchronizing signal separator.

Q Is that exactly the same signal being applied along this line and down the arrow into the synchronizing signal separator on Exhibit 86?

A I am not indicating any functional operation on the signal.

Right.

I don't know if I have answered the question.

Q Perhaps now that we have clarified the purpose of that black line that runs from the point you have marked "Video Signal" across to the left and down into the synchronizing signal separator, you could again summarize just how the composite video signal of Exhibit 83 is utilized, broken up and utilized, by the television receiver. Just functionally.

A The video information which is below the blanking level, which is represented by the yellow curve of Exhibit --

THE COURT: Excuse me a minute. I am not really sure that I am being helped as much by these exhibits as I would be by a narrative description. I am sure it is my fault, rather than the fault of the exhibits.

I tend to get confused to some extent by these drawings.

Could you give me a narrative of what you said without reference to these exhibits, and just let me listen to what you say and con-- centrate on it rather than trying to follow these big blocks.

THE WITNESS: I will try.

THE COURT: My mind tends to be more literary, I think, than mechanical.

THE WITNESS: Well, I think the point I have been trying to reach is that -- well, keep in mind that I want to be able to represent a two dimensional image and to prepare a number of two dimensional images.

THE COURT: I understand. Frankly, I thought I had it pretty well in mind until we got to this

last exhibit, Exhibit 86.

I am frankly confused by it.

THE WITNESS: It is an attempt to schematically illustrate components in the television receiver, in the broadcast television receiver, which have specifically identifiable functions.

The video amplifier prepares a signal which controls the strength of the electron beam. That is how we control the brightness. But at the same time it is not enough to just control the brightness of the beam. We have to deflect it.

Not only do we have to deflect it, but we have to deflect it synchronously with the television transmitter to have a coherent image.

We deflect it in a systematic manner, which prepares the raster by the deflection coils. Excuse me. The deflection circuits.

The deflection circuits cause the beam to be deflected across the screen and generate the raster pattern. At the same time, we control the intensity of the beam. So the brightness of any spot on the screen which is being illuminated is controlled by the voltage being sent by the transmitter, the video signal.

The timing information which determines

the position of the beam on the face of the screen is both the horizontal synchronizing pulses and the vertical synchronizing pulses. These are being prepared at the transmitter. It starts a line.

First of all, it transmits a synchronizing pulse, and then the information contained by the brightness of the image that we would like to represent is transmitted to the broadcast receiver, where it is received and prepared for display.

The intensity of the voltage, as I have said, determines the whiteness or blackness. The greater the voltage being transmitted, the more black it makes the beam. The smaller the voltage, the more white becomes the beam.

But the television station in particular is not transmitting the information which determines the position of the beam instantaneously. All it does is start the sweep, the vertical and horizontal sweep, which are taking place in the television receiver by the deflection circuitry, the horizontal deflection circuitry and the vertical deflection circuitry. They are moving the beam at a uniform rate from left to right and from top to bottom.

At the very instant that the beam reaches a position in which a picture element is to be displayed, the voltage level on the video signal generator determines the electron beam in just the right proportion.

If I want the picture to be brighter, the voltage at that level which goes to the video signal, which controls the electron beam, varies in that proportion.

Perhaps Mr. Anderson's analogy of taking a garden hose and sweeping it back and forth, and I can imagine varying a nozzle, and I can vary the strength of the water coming out, but the television picture tube is doing very much the same thing. I think he mentioned a good analogy.

The electron gun is actually varying the strength of that water. Except in our case the strength of the electron beam determines the brightness of the picture.

THE COURT: I follow what you are saying, I think. This is a little bit like the old radio series. I used to like those better thant the TV counterparts, because I used to like to give my own picture.

I think my own mental picture of what you are saying is more helpful to me than some of these diagrams. This is no reflection on the diagrams. Your diagrams are those of the electronics expert,

and they are perhaps less meaningful to me.

THE WITNESS: I apologize for that.

BY MR. ANDERSON:

Q Dr. Ribbens, is it possible to verbally, perhaps, tell the story of Exhibit 86 in the sense that you have described this composite video signal of Exhibit 83, and then just in verbal terms explain how the various parts are pulled out by circuits and used to generate a picture, the various parts of the composite video signal, in a very general and verbal sense?

A First of all, I --

THE COURT: I think I have that. Basically it all comes in together, and you have got to break it down, and then get it back together again.

THE WITNESS: Yes, and the coming together takes place in the picture tube itself. This is where it really is important --

THE COURT: I think I have the general idea.

THE WITNESS: Unfortunately, it is natural for me to want to draw a block diagram, because I spend most of my time doing that.

THE COURT: Tell me the reason, and this is probably very elementary, and something I should know from everything you have said, but why is it

necessary to break it down? Why can't you just scan it in the same form in which it is received from the transmitter?

THE WITNESS: Well, I think we really are. I think it is just that we have to be able to separate voltage levels here. I wouldn't want my deflection circuit to respond to a voltage level which corresponds to picture information. There may be a voltage level which corresponds to some picture information that looks very much like a synchronizing pulse, and if it responded to any old voltage that came along, I could start the trace down here.

THE COURT: So what you receive from the transmitter is really too diffuse to be used, is that correct?

THE WITNESS: I guess. I think it is too imprecise, if I don't attempt to identify the voltage levels. There is too much of a possibility of an error if I were operating down in this region here (indicating).

BY MR. ANDERSON:

Q Dr. Ribbens, isn't it a fact that you have to separate out that synchronization information for the purposes of reconstruction?

A Yes.

Q I don't know where your chart --

A What are you looking for?

Q I was looking for the paste-up thing, Exhibit 79.

A Yes.

Q Isn't it a fact that if you didn't separate out this horizontal information but just ran the "hose" back and forth without knowing when to start, it might end up, say, like to the left or right, like this, as I have tried to show in your paste-up, Exhibit 79?

A Yes. I don't know if I made that very clear, and I apologize if I did not.

Q Perhaps if it is not clear, you could amplify my comment in response.

THE COURT: Except, don't you get the vertical and horizontal sync signals from the transmitter?

THE WITNESS: Yes. If it is a broadcast television. Whatever the source is. It may not be a broadcast television station. But I have started out with a broadcast television idea, in which there is a transmitter which produces synchronizing pulses.

THE COURT: But the TV set isn't able to distinguish adequately enough between what is a horizontal sync and what is a vertical sync and what is a video signal. Is that correct?

THE WITNESS: It can. That is why I have drawn the functional block diagram as distinct components.

THE COURT: That is only by virtue of segregating.

THE WITNESS: Yes. We have to separate them. That's right.

THE COURT: Because if you didn't separate them --

THE WITNESS: You might make an error.

THE COURT: -- they would get jumbled up, perhaps.

THE WITNESS: That's right. There would be a possibility of error.

THE COURT: Have I stated the basic proposition?

THE WITNESS: I think so. It sounds right to me.

I think all we need to think of is in the television receiver we have circuitry which is deflecting the beam. We just want to start that deflection at the right time, both horizontally and vertically, and if we have started it at the right time and it moves at a uniform speed, that is the sawtooth waveform.

BY MR. ANDERSON:

Q Perhaps the one link in the chain, Dr. Ribbens, that we haven't explained very much at all is just generally how at the transmitter the composite video signal is put together, by whatever devices are used, to scan the picture and then add to that vertical and

horizontal synchronization.

THE COURT: We are talking about a transmitter in the case of a regular TV picture, we are talking about the television station, right?

THE WITNESS: Yes, and it is easiest to think of that station as having a camera which is bisecting an image by this scanning procedure. It would have in it circuitry which would generate synchronizing pulses. The picture would be dissected in response to the synchronizing pulse.

BY MR. ANDERSON:

Q I might just ask for context purposes, Dr. Ribbens, at this point: Is the fundamental that we are talking about, of building the composite video and then breaking it down in the receiver, any different in the gaming devices that we are talking about, as compared to the transmitter of a program?

A Not really.

Q If so, state why. You said not really?

A Not really, because we need to send to the television receiver synchronizing pulses and video information, and they have to conform to a certain standard format.

Q And that is true whether it is a game or a

television station?

A Right. The gaming video waveforms, as I think I have indicated by these charts, have a different waveform. They are specific. They tend to switch square waves rather than to vary continuously.

As I vary the video signal continuously, I can have shades of gray. But in the video games we either tend to have the beam on or have it black and white.

THE COURT: I think I am adequately educated on this portion of it.

BY MR. ANDERSON:

Q Would you go on, Dr. Ribbens, and explain?

A I think one of the next things I was going to do was to give one more video signal waveform, in which I indicate the possibilities of displaying two white dots on a black background, because that tends to be characteristic -- that is at least a beginning illustration of a number of representative games.

That is Exhibit 87.

Once again I am resorting to video waveforms.

At the lower portion of Exhibit 87 we have drawn schematically the face of a cube, in which there will be a black background and two white rectangular

dots.

The top of that exhibit indicates a video waveform in which voltage is the ordinate going up and time is the abscissa. I have also indicated a vertical synchronizing pulse, the horizontal video pulses and some lines on which the picture is to be displayed. This is similar to the display I have shown on Exhibit 85, where I have just a single spot, except I have compressed the time scale so that I can show vertical pulses and have the possibility of having two dots displayed.

The horizontal synchronizing pulses will continue to come along at a uniform rate. But I just simply haven't depicted them in the drawing.

In our simplified video waveform, I have shown four lines in which the voltage level changes from black to white. So the portion labeled Time interval, t_{x1}, from this pulse is a time interval which determines the distance from the left edge of the screen to the beginning of the dot, and I have labeled that distance X_1.

So the time t_{x1} is proportional to X_1.

If I had circuitry by which I could control the time interval labeled t_{X1}, that is a time interval from the synchronizing pulse to the beginning of this video waveform, if I could change that time interval, I would have to do it, of course, in each succeeding line.

Keep in mind that each interval between successive synchronizing pulses is the time interval of one line. If I could cnntrol that time interval, I could control the distance X_1, the distance being the distance to the left edge of that displayed spot.

Similarly, if I had circuitry which permitted me to control the time interval from the top of the picture, that is, the first line in the picture, to the first line containing picture information, and I have labeled that time interval t_{Y1} -- if I can control that time interval, I can control the distance which is labeled Y_1.

So by adjusting a knob, if you will, I can change the number of lines -- I would be shifting all four of these lines back and forth along this picture by varying a knob.

If I do that, I can cause this symbol to move up and down.

That particular process is done in the

video games. In fact, the two knobs on the front of this Pong, Exhibit 10, function in such a way as to cause this time interval to change and thereby cause the distance Y_1 to change.

If I can do it for one, if I can provide this time variation for one spot, I can also provide the time variation for another spot, which we have labeled with a subscript 2, and I can vary its vertical position, and I think you have seen, your Honor, in the -- I believe you have seen the video games demonstrated.

By varying the knob, the spots move up and down.

What is really happening in particularly the Pong game is that to vary the number of lines which occur before I present the video information, that corresponds to varying the time interval labeled T_{y_1}.

Q You said that is true of the Pong game. Is it also true of the Odyssey game and the disclosures of the patent in suit?

A Yes. Yes, it is.

Q Then I think, if you can, you should go on, and is it possible now to relate that fundamental explanation of video waveforms and the block diagram of the television set to the patents in suit?

A Yes. For that purpose I have Exhibit 88 which,

once again, is a block diagram.

This is a block diagram of the control package, that is, Exhibit 88 is, for the video game.

The television receiver is not shown on this.

I am assuming that this is the final output, that is, the lower right portion of this exhibit is final output, of our electronic circuit, this package.

This would in many cases be a pair of -- that is the twin lead antenna, and this would go off to the antenna terminals of the television receiver.

Q Does that signal comprise the composite video signal that you have been talking about in your explanation previously?

A Yes. I had hoped to get to that.

Q Excuse me. Go right ahead.

A That would comprise the composite video signal. That is correct.

I think it is helpful to recall once again that in our previous exhibits we have tended to color code various blocks and various portions of the drawing for easy identification. Once again I have used the color coding scheme that red represents the horizontal synchronizing information, and in Exhibit 88 the upper left block is color coded red and labeled

"Horizontal sync generator."

This device generates horizontal synchronizing pulses. It actually generates these pulses that are color coded red in this exhibit (indicating). It actually sits there and generates those pulses.

You will notice it is connected functionally to a block that we have labeled "Paddle 1 generator".

Also, I have a block below the horizontal sync generator block which is color coded blue and labeled "Vertical sync generator".

This provides vertical synchronizing pulses, and I guess I have to go back to Exhibit 87 to indicate that it would be generating pulses such as I have drawn here in the blue. It just continues to provide these signals, and the television receiver will respond to the synchronizing signals, and it will generate a raster in response to these synchronizing signals if I have connected through the block labeled summer and modulator and through this wire to the antenna terminals.

Q Dr. Ribbens, perhaps with respect to Exhibit 88 you could explain just verbally, without the details of the blocks, what the entire chart represents, and just in the broadest functional way explain what happens from input to output, and then, as required, go to the specific blocks.

A All right. Exhibit 88 is intended to indicate that I have circuitry for generating and displaying three spots. Two are player controlled, called Paddle 1 and Paddle 2. These will be manipulated by the players by controls which are labeled Paddle 1 and Paddle 2.

I also have a third spot, which we have called the Game Spot, and this is the block labeled Game Spot Generator, which represents the circuitry necessary to generate that game spot.

These will be combined and displayed on the television picture tube.

Q Is the game spot in the context of the subject matter here?

A This would be analogous to a ball in a game of tennis or ping pong, for example.

Q Is it identified in the patents with any other term?

A It is called a hit spot in the patents in

suit.

Q And the paddles?

A They are often called hitting spots.

Functionally, the game operates -- this is a block diagram which tends to explain the game Pong, among others, in which I have a set of controls which can be manipulated and which cause the display spot represented by Paddle 1 and Paddle 2 to move vertically.

In Exhibit 88 we haven't indicated whether these give only vertical motion or vertical and horizontal motion, but for convenience we can think of moving the paddles vertically. That would be analogous to varying the time interval t_Y on Exhibit 87.

To make an interactive game out of a circuit such as this, a typical game might be to simulate a game such as ping pong or tennis, in which Paddle 1 and Paddle 2 would simulate the paddles in a ping pong game and would attempt to intersect a game spot which is moving. This is moving under control of electronics in this package, whose block diagram is Exhibit 88.

It is important for the purpose of the game to identify coincidence, so that when the ball actually collides with the paddle, we change the circuit configuration to cause the ball to reverse and move in

the other direction.

THE COURT: I may be anticipating something you are going to talk about, but how is it that the size of the ball and the size of the paddle remains constant?

THE WITNESS: I think I can discuss that shortly. But that is determined by the circuitry and the design. In other words, you have asked a good question. We are changing the time interval between the top of the picture and the displayed spot. Why are we not also changing this time interval (indicating)? That is a good question.

It happens that the circuitry which produces this characteristic video waveform can be designed to produce a constant time interval which is called t_W.

BY MR. ANDERSON:

Q Dr. Ribbens, I would like you to refer to the two patents in suit, the Reissue Patents 28,507 and 23,598, and explain whether or not you have prepared the chart you are now referring to, Exhibit 88, based on either of those patent disclosures?

A Yes. This is a composite block diagram which

embodies some of the ideas of both of those patents.

Q And you did prepare this chart yourself, did you?

A Yes. With the help of Mr. Williams. He saw that it was drawn.

Q Proceed, if you will, to explain the block diagram, and later we will have you relate it specifically to the two patents in suit.

A As we said before, one of the important aspects of the game play which makes it interactive is to have the spot moving in response to game controlled conditions, so that this would tend to simulate the natural play in a ping pong game.

The ball would move, at, let us say, as an example, a uniform speed. That is not necessary, but just as an example. The player would take as his objective to intercept the path of that ball with his paddle.

So by varying the controls, he can vary the position of the displayed symbol which simulates his paddle. If he is successful in providing displayed collision, that is equivalent to having coincidence in an electrical sense between the game spot and either of the two paddles.

So we have a block on Exhibit 88 which is labeled "Coincidence Detector." The patent -507 and -598

also teach the method for determining coincidence between the game spot or hit spot and Paddle 1 and Paddle 2, which are called hitting spots in those patents.

In response to that coincidence, the circuitry which controls the motion of the ball is changed, so there are actually circuits which are altered, voltage levels which can change, or signal levels which you can change, and the signal levels determine the motion of the simulated game spot on the screen.

I have another exhibit which gives somewhat more detail in describing the function of the coincidence detector and the way in which it can influence the motion of the spot.

Also, we have indicated the possibility of having a ball simulate a bounce off, an edge, which could be thought of as being a fixed visible barrier or a fixed hit symbol, and there is a block on Exhibit 88 which we have labeled "Edge bounce".

So Exhibit 88 just tends to be a composite of some of the ideas of both '507 and '598.

Q Dr. Ribbens, you have referred to the block you labeled coincidence detector and the three arrows, game spot, Paddle 1 and Paddle 2, coming into that coincidence detector.

Can you explain how the coincidence detector functions and what those inputs are with respect to the paddles and game spots?

A If I understand your question, the arrow labeled Paddle 1 actually represents a connection between the circuitry which generates this signal corresponding to Paddle 1, and the arrow which is labeled game spot actually corresponds to a physical connection between the output of the circuitry which generates the game spot and the coincidence detector.

So there is actually a physical connection between these two (indicating) and between Paddle 2 generator and the coincidence detector.

So the electrical voltage which is varying

and representing on the television picture tube these symbols is connected to this circuitry labeled "Coincidence detector".

Whenever the signal corresponding to the game spot and the signal corresponding to the paddle detector exist at the same instant of time, that causes the coincidence detector circuitry to change in such a way as to alter the signals corresponding to the control signal generator.

Functionally, and in a block diagram sense, the control signal generator prepares signals which determine the motion of this game spot generator.

This is a very schematic sense, and there are a great many ways in which this could be implemented.

Q Could you refer to Plaintiff's Exhibit 87, the signal format that includes two spots, and assume that one of those spots is a game spot and one a paddle spot, and just generally explain coincidence in that context?

A That is a good idea. Let's assume for the moment that what we have called Dot 1 in Exhibit 87 represents the player spot. The hitting symbol. And let's assume Dot 2 represents the game spot.

As the game spot moves or the hit spot moves, you can think of the display that is depicted

in Exhibit 87 as shifting one way or the other. When they come into coincidence, that corresponds to the set of pulses which we have labeled Dot 2, superposing on the representation of Dot 1 -- they actually occur at the same time in the composite video waveform, and it is possible through a logic circuitry and through a number of other implementation schemes to detect coincidence between these different signals.

Q Are those implementation schemes and circuitry described in the '507 patent?

A Yes, they are. Very definitely.

If you will, you can think of the time, called t_{Y2} and t_{Y1}, as change, which would correspond to the motion of the game spot under the influence of the control signal generator of Exhibit 88, and the motion, for example, the vertical motion of the hitting symbol, Dot 1, in our representation as being controlled by the knob, and that would -- controlling the knob, as I have said before, causes a shift in the position of the waveform associated with that dot.

THE COURT: If only one horizontal pulse is coming on to the screen at any one instance, how is it that you are able to have two separate or sometimes three separate spots moving simultaneously, or apparently simultaneously?

THE WITNESS: They come at different times in the complete time interval that represents the picture. This vertical sync would determine, let's say, the top of the picture. The top of the picture is labeled on Exhibit 87 -- well, it would come right here (indicating.)

THE COURT: Two players, however, are moving the paddles around the screen in an up and down fashion simultaneously. I don't quite see how that can be done with only one line going across the screen in any one point in time.

THE WITNESS: Now I understand. You mean if I had both symbols occurring at the same vertical position on the screen?

THE COURT: I could understand that. Just by use of the horizontal syncs. But how do you get -- do you understand my question, Mr. Anderson?

MR. ANDERSON: Yes, your Honor. I think I do.

BY MR. ANDERSON:

Q Dr. Ribbens, I think perhaps if you can go back to the chart, Exhibit 88, or talk from it, perhaps without necessarily using it, you have described how the horizontal sync generator, the red block, applies a signal down to the summer and modulator, and also inputs to the Paddle 1 Generator, and I think you have not explained at all yet with respect to Exhibit 88 how the Paddle 1 control operates to cause some signal change which causes just Paddle 1 to move and not have an effect on Paddle 2, for example. Is that it in essence?

THE WITNESS: I didn't perceive that as being his question.

THE COURT: No. I think that is not quite it.

For instance, maybe I have forgotten how this game works, but you might have Paddle 1 at the top left and Paddle 2 at the bottom right.

MR. ANDERSON: That's correct.

THE COURT: Now, two players are moving their knobs simultaneously, and the position of those two paddles may be reversed on the screen.

THE WITNESS: Yes.

THE COURT: It is hard for me to understand how all that can happen when you only have one line going across that whole screen at any one time.

THE WITNESS: But that one line can contain all of the information necessary to construct the complete picture, to slice through the picture at that particular point.

This is the way I perceived the question.

Let's consider for the moment that both dots would exist at the same vertical position, for example. That can be understood. But Exhibit 87 is a very poor representation for that, because its time scale is too small. If I could expand this time scale out so that we could study in great detail the events which occur between successive synchronizing

pulses, I would see two such marks between each synchronizing pulse. (indicating).

That is, if this dot and that dot occurred at the same vertical position.

Instead of having just one such transition from black and white, I would have another between the same pair of horizontal synchronizing pulses.

THE COURT: I can understand that. Now move them up and down in relation to your exhibit.

THE WITNESS: That can happen by simply varying the time levels from the synchronizing pulse. I think one of the things that is confusing, perhaps, is that this time scale we have chose compresses phenomena to too small a pictorial representation. In fact, the time of occurrence for the pulse corresponding to one symbol on a TV game will be very small compared to this time interval (indicating).

If I were to expand the time interval of the horizontal synchronizing pulse to perhaps the full width of the chart, then the width of a single symbol would be more or less analogous to the width I have drawn.

So there is a great deal more space in here than there is video signal.

The video signal actually stays at the blanking level for most of the trace but makes two transitions in the example we are considering from black to white.

But, you know, this is not to scale at all. This would make a spot which is very much winder than is useful for effective TV game plan.

So by independently controlling the time of occurrence of the dots in any horizontal line, and I can do that independently, because I have a pair of paddle generators, then I can control the time of occurrence from the synchronizing pulse to the two successive video signal changes.

THE COURT: I guess my problem is that I conceive of this raster scan as going from upper left to lower right, and I conceive of that as imposing some kind of limitation on the amount of motion you could have to generate at one time.

That is my error.

MR. ANDERSON: Yes.

THE COURT: I don't realize that speed that is involved here.

MR. ANDERSON: I think perhaps the question involves whether or not you can impart apparent motion just in one frame between two vertical synchronizing pulses.

A Right. No,you can't. That corresponds to -- in, let's say, the motion picture -- one single image, so that between successive vertical synchronizing pulses, that is, in one image, we have the spot at one position. Then the next picture, the time of occurrence of this Dot 1 would change if you were simulating motion. Yes, if I were causing this paddle to move up and down, then in, let's say, the first picture I would have a time interval as indicated t_{Y_1}.

X is a poor example, because we have been considering vertical motion. I would have time interval t_{Y_1} in the example we are considering.

In the next, time t_{Y_1} would change. I would have to let a complete string of horizontal picture elements go by and wait until the next vertical synchronizing pulse. Then it occurs. Following the second synchronizing pulse, if there's a motion, t_{Y_1} would be different.

Q Am I correct in any given picture there is no motion?

A That's right.

Q It's a static complete picture?

A Yes.

THE COURT: Each set of controls is operating on that picture?

THE WITNESS: Well, it's providing control voltages which affect the motion of these -- at any instant of time, you are right, that's right. I think I perceived your question wrong at first.

At any instant of time, even if I'm moving the paddle controls, at that instant of time it will determine a particular time interval following the synchronizing pulse for the occurrence of that pulse.

But I think Mr. Anderson has made a critical point in that each interval of time on the video signal between synchronizing pulses corresponds to a static fixed image. If you could somehow look at the television picture and turn your eyes off for an instant, you would see the paddle in one position. Then if you could turn your eyes on and off for the next one, if there's motion, the spot would be in a different position. That could correspond to a different time delay.

BY MR. ANDERSON:

Q But another fixed position in the second frame or picture would be again fixed, but because of the successive different fixed positions, the viewer gets the perception of motion, is that correct?

A That's correct.

THE COURT: That, I have no problem with. It's just having things moving in opposite directions is what gives me the -- simultaneously -- is what gives me the problem, but I think I am beginning to get it.

THE WITNESS: That could correspond to maybe t_{Y_1} increasing and -- if I were to cause t_{Y_1} to increase, that would be analogous to moving Dot 1 down.

BY MR. ANDERSON:

Q That would be player 1's control direction that would do that?

A That's correct.

And if I were to cause t_{Y_2} to decrease by changing player 2's knob, that would be equivalent to moving Dot 2 up.

Q And the two can occur apparently simultaneously?

A Yes, because they are independent controls.

THE COURT: This might be a good time to take a ten-minute recess.

MR. ANDERSON: Thank you, your Honor.

(There was a brief recess, after which the following further proceedings were had herein:)

THE WITNESS: On the break, it was suggested to

me that I might try to recapitulate a little bit about the idea of simulating motions, and get an idea of the time scale involved in displaying complete images, and, in fact, it was suggested that I maybe could use this white pad and a pen, and talk about a representative -- a sequence of images that would be displayed on the face of the television tube, keeping in mind that these are a thirtieth of a second apart.

Let's imagine that we have just simply two displayed spots under the control of two players.

I might illustrate the face of the TV picture tube with this rectangle, and one dot as being at the upper left, the other at the upper right.

BY MR. ANDERSON:

Q You mean lower right?

A I beg your pardon?

Q Lower right?

A Oh, lower right, thank you.

And we will imagine that the players are moving the controls in such a way as to cause the upper left to move down and the lower right to moe up.

Almost regardless of the speed at which

they move their controls and the speed at which the symbol appears to move, there's -- the next frame that would come along would have a markedly small displacement in the actual position of the object.

I might start in the next frame by drawing a dashed square indicating the position of the spot in the previous picture, and then indicate just below that, somewhat below that, a solid square, indicating the position for this frame, the dot on the left. I will call this 1 and this 2.

And I will do a corresponding representation with a dashed square in the lower right, and use a solid square up above it to indicate --

Excuse me, the symbol at the left, I will number 1, and the symbol at the right, I will number 2.

So each one of the frames depicts the position -- draws a picture of the symbol, if you will, at a fixed position. The motion comes in succeeding pictures. So, it's possible to have motion continuing-- that is, it's possible to have the symbol labeled 1 at the left continuing to move down.

Now I will draw a pair of dashed squares, indicating the position of that spot in the previous two pictures that were displayed on the television screen, and, finally, with the solid square, indicate the position of symbol 1 in the third frame.

Correspondingly, I can do the same for spot No. 2 -- oops -- I mean to make that dashed -- I am drawing two dashed squares indicating the position of symbol 2 in the previous two pictures, and then a solid indicating the position on the third.

I could continue on this way indicating motion.

So, the motion does not take place during one frame. And in terms of the waveform for a single picture, I would have just a single fixed position of that waveform.

THE COURT: And each picture that I would see with my eye, or, actually, each picture which would

go in to make up the motion that I would see with my eye would be displayed on a complete scan of the whole screen, is that correct?

THE WITNESS: That's correct. Each one of these would represent the full number of lines.

THE COURT: The full scan of the whole screen?

THE WITNESS: That's correct, that's absolutely correct.

BY MR. ANDERSON:

Q How frequently does that occur now?

A The complete pictures take place 30 times a second, so a complete picture would take place in a thirtieth of a second.

Q So you have shown the progression of three intervals of one-thirtieth of a second, or only a time span of a tenth of a second in your entire sketch there?

A Yes. This is one-thirtieth of a second.

THE COURT: Can you give me an idea of the time interval that the eye can actually discriminate between pictures?

THE WITNESS: Have you ever seen silent movies shown at silent speed?

THE COURT: Yes.

THE WITNESS: Those are 16 frames a second, about

the same as home movies, and you can see the flickering. When you project on a large screen, you tend to be more sensitive than on a home movie screen, but 16 frames a second, that is a sixteenth of a second, and it gets to flickering.

A television receiver, you actually show half of the picture, not the top half, but every other line in a sixtieth of a second, so light is presented to your eyes in a sixtieth of a second, which gives your eye even less time to perceive flickering. It makes the motion to appear to be even more continuous.

MR. ANDERSON: We will mark Dr. Ribbens' sketch as Plaintiffs' Exhibit 98.

MR..GOLDENBERG: I just want to have a quick look before it disappears.

THE WITNESS: My drawing isn't very good.

BY MR. ANDERSON:

Q Perhaps, Dr. Ribbens, just quickly to complete the series and relate it to the question that was posed before the break of the total reversal of the left-hand spot and the right-hand spot, draw the one or two more sketches to show the complete reversal of the two spots, the upper left to the lower left and the lower right to the

upper right.

A All right. I will just draw the solid positions.

Q All right, fine.

A I have represented six successive pictures displayed of the symbols and their corresponding positions progressing from top down on the left and from the top down on the right, sequentially, indicating that dot No. 1 started at the upper left, and No. 2 at the lower right, and they end with No. 1 at the lower left and No. 2 at the upper right.

And I have indicated only six elements to cause that much motion. That would be six-thirtieths of a second, so that would be extremely fast motion, and your eye would have difficulty perceiving it.

So, even in the drawing on that pad, I have tended to compress the time scale considerably.

THE COURT: All right.

BY MR. ANDERSON:

Q Now, in the circuits disclosed in the patents, there are two player controls that would perform basically what you have illustrated in Exhibit 98, is that correct?

A That's correct, that's certainly correct.

Q Again referring to Exhibit 98, is it possible to just generally describe in terms of the circuits of the patents or the function disclosed in the patent, how the player control would cause either pulses to be generated, or cause those spots to assume these successive positions?

A Yes. The circuitry as taught by patents '507 and '598, operate in conjunction with the synchronizing pulses, both the vertical and the horizontal synchronizing pulses, and the position of the voltage waveform which causes the symbol to be displayed changes with respect to the synchronizing pulse.

There's a time delay between the synchronizing pulse and the time of occurrence in each one of these frames, and by moving the player control knob, there would be a change in the time relationship from the synchronizing pulse to the displayed symbol in successive frames.

Q Then the synchronizing pulse might be considered to be occurring up at the top of the first frame

of Exhibit 98?

A Well, I think, functionally, that's -- I think, functionally, we might think of the vertical synchronizing pulse occurring up here. Actually, that's just a schematic eye concept. We can think of the horizontal synchronizing pulses coming over here and starting each line, even though in the receiver itself the synchronizing pulse initiates retrace.

Q The player control, then, generates another pulse relative in time to those?

A That's correct. The player control would generate a voltage pulse which would occur in timed relationship to the vertical synchronizing pulse and the horizontal synchronizing pulse.

Now, if the motion were to be only vertical, then the change in time from between successive frames would be with respect to the vertical synchronizing pulse. That is, we would change the number of lines which occur before the symbol is displayed in successive frames to cause the apparent motion to take place in the vertical direction.

THE COURT: What is happening when everything is standing still?

THE WITNESS: Then the time relationships stay fixed. Each successive frame would have the same

time relationship from the synchronizing pulse to the symbol.

THE COURT: Everything is still moving and scanning?

THEWITNESS: Yes.

THE COURT: It's just that the syncs have not been changed?

THE WITNESS: The time relationship between the synchronizing pulse and the voltage pulse or the waveform would not change, that's right.

If you were to examine the waveform in successive intervals for different pictures, you would see exactly the same time interval between the sync pulses and the signal waveforms.

BY MR. ANDERSON:

Q Then each frame is identical if there is no motion at a given time?

A Yes.

Q And the signal format that generates that would remain the same, is that right?

A Correct, correct.

Q Now, there is a pulse then that determines the location of player number 1 in the upper left-hand corner of your Exhibit 98?

A Yes.

Q And player 1 controls the timing of a pulse that determines where spot number 1 is going to appear vertically?

A That's correct.

Q And then am I correct that player 2 has a knob that controls the time when a pulse is generated which causes the player 2 spot to appear at a given vertical place?

A That is correct.

Q And are they completely independently controllable by player 1 and player 2 so they each generate their --

A As taught by patent '507 and '598, they would be independent controls.

The circuitry associated with each player's control would receive a synchronizing pulse, and generate at some time delay later a pulse corresponding to the symbol we are trying to display.

So, we begin with a synchronizing pulse, generate a time delay, generate the pulse. That determines the position on the screen at which the symbol is displayed.

Q Now, are those two timing pulses generated independently by the two players then handled in the circuits of the '507 and '598 patents in some sort of separate

circuit channels?

A Yes.

Q Could you just briefly explain that?

A Might be easier if we used another exhibit.

Q All right, would you please do that? Is this from one of the patents?

A Exhibit 89 is a copy of Figure 12A and 12B of Reissue 28,507.

As taught by this '507, the game which is being represented by the pair of figures, 12A and 12B, could be thought of as a simulated ping-pong game in which I have a pair of symbols -- figure 12B is actually a schematic drawing of the face of the television screen. I would be displaying three symbols, a symbol under the control of one player which we have labeled A, and it's drawn in with a diamond shaped figure to give it a specific identification, and it's labeled 123 in Exhibit 89, and the symbol under control of player B is labeled 124, and it's also a diamond shape.

According to the teachings of -507 in this particular example the player has control over the vertical position of symbols A and B.

The game spot is represented in Fig. 12B by a circuit numbered 113.

So, I would have in this particular example three separate symbols, two under control of the players by means of knobs which are connected to circuit elements, and one which is under the control, at least partially, as we will get into in a moment, of the game. That's the simulated ball represented by the circle. So, I have three separate function generators which operate in conjunction with the synchronizing pulse generator.

Fig. 12A illustrates, in a block diagram way, the kind of important functional elements contained in a device such as this. This is an apparatus for simulating a ping pong game. We are using our same color coding scheme. The blocks of blue color are the vertical synchronizing generator. It's necessary to generate synchronizing pulses for the television receiver to cause the sweep to occur at the right point.

We also need to generate the horizontal synchronizing pulses. That also appears in the television receiver.

The blue line connecting vertical sync sawtooth generator and the block at the right labeled "Summer and R. F. Oscillator" indicates that the vertical synchronizing pulse would be available to go to the television receiver.

Similarly, the line connecting horizontal sync sawtooth generator and the block labeled "Summer and R. F. Oscillator" indicates the horizontal synchronizing pulse will be available to the television receiver to cause it to generate a raster in synchronism with the device itself.

Now, in addition, we are indicating functionally that the vertical sync sawtooth generator is connected to both -- excuse me -- to all three spot generators, spot 1, spot 2 and spot 3, which are respectively Paddle A, Paddle B, and the ball, as depicted graphically in Fig. 12B.

The importance of the connection between the synchronizing signal generators and the symbol generators was alluded to previously by Mr. Anderson in that we determined the position on the trace -- excuse me -- on the face of the picture tube by the time delay from both the horizontal synchronizing pulse and the vertical synchronizing pulse to the pulse corresponding to the

appropriate symbol.

So, basically, what these blocks labeled spote 1, 2 and 3 generators do is to vary the time delay between the synchronizing pulses which they receive and the output pulse which they generate, which is color coded yellow, so that each one of these spot generators produces an output pulse, and you will see a yellow line connecting each of the three spots to a block labeled OR Gate and Pulse Shaper." This is intended to prepare the composite video signal, to add it all together, if you will, so that all of these signals can appear on the television receiver.

Q Is the composite video signal put together in its entirety in the OR Gate?

A No. The video information -- that is, this is the voltage which controls the electron gun -- is indicated as being prepared in the OR Gate, but the block labeled "Summer and R. F. Oscillator," actually the summer portion of this -- summer in the sense of summing, as to add -- combines the video information from the three spot generators with the synchronizing pulses so that the waveform will be as we showed in our earlier exhibits of a video varying waveform with synchronizing pulses which go above that voltage, the video level, that is, in the blanking region.

So we will have a television signal with a proper format to be used with a television set.

Also represented in the block labeled "Summer and RF Oscillator" is the RF oscillator, and this particular example is intending to show that it's possible to connect the video signal right to the TV antenna terminals without disassembling the television receiver in any way, and connecting it to the video signal source.

So, it modulates an RF carrier, and, in a way, tends to simulate a broadcast television station so that we can use this device with a broadcast television receiver without any modification. We can simply connect the output wire to the antenna terminals -- let's see -- I don't know if you can see this --

THE COURT: I can get down there -- yes, I have seen it.

THE WITNESS: You would connect, as shown by Figure 12A, you would connect this two pair of terminals labeled VHF.

And then you would simply tune the television receiver to the appropriate channel which would be identified by the manufacturer of this device.

THE COURT: How would that be determined, incidentally? What channel would be involved in this?

THE WITNESS: Well, it is pretty much free choice. I guess ideally you would like to pick a channel which didn't correspond to any of the broadcast stations in the community, because there is some possibility of having interference from that channel. So you would like to pick a channel that wasn't being used in that locality, and you would like to provide a number of choices to the user as an example.

Although to some extent by making connections to this point here and by collapsing the television antennas, you will tend to minimize the possibility of interference from an outside broadcast station.

THE COURT: What portions of the TV set itself are used?

THE WITNESS: Essentially everything except the antenna.

This particular example illustrates a

summer and RF oscillator. So we would enter the television receiver right at the radio frequency tuner.

THE COURT: So basically what you have done is you have transmitted it to the receiver, and then the receiver starts over again, and --

THE WITNESS: Absolutely.

THE COURT: -- and does its regular work, just as it would if it were receiving a TV signal from a commercial transmitter.

THE WITNESS: Absolutely right.

BY MR. ANDERSON:

Q Dr. Ribbens, is that true in the case that you have just described,using that Magnavox Exhibit 6, or in all cases where TV games are played on TV display?

A Is what true, the use of an RF tuner?

Q The use of all the parts of the receiver. As I understood it when you were describing Plaintiff's Exhibit 86, you indicated that certain portions, the color portions, were utilized in processing the video information.

A Well, the irreducible minimum number of components of a television receiver which we can use are the color coded portions. If we were not to modulate the carrier with the video signal, then we would con-

nect the signal directly at the video amplifier.

Q Do the patents have any teaching with respect to how the video signal should be brought into the video amplifiers and deflection circuits?

A The patents teach either as an alternative.

Q Either what?

A Either connecting the video signal from the summer of Fig. 12A, Exhibit 89, to the video amplifier or, alternatively, modulating that signal on an RF oscillator and connecting to the antenna terminals of the television receiver, which would enter the radio frequency tuner and then function as an ordinary broadcast television receiver.

Perhaps, to continue, I might call your attention to another aspect of the teachings of patent '507, which is also continued in '598, which is the importance of detecting coincidence between the symbols represented by spots 1, 2 and 3. There is a block on Exhibit 89, numbered 121, called "Coincidence Detector". This is an electric circuit, which is connected -- we haven't shown the connection, but it is labeled Spot 1 Video Pulse, Spot 2 Video Pulse and Spot 3 Video Pulse, indicating that there is a connection between the corresponding line on the coincidence detector and spot 1 and a similar connection -- it actually would connect

right to the output here (indicating.)

So we take these voltage pulses which correspond to the symbols and connect them to the coincidence detector.

Whenever the spot 3 generator symbol or voltage pulse coincides with the spot 1 or spot 2 symbol generator pulses, then this circuit responds to that condition and generates an output which changes the functional components called flip-flop in Exhibit 89, numbered 122.

So any time there is a coincidence, it causes a change in this flip-flop circuit, and flip-flop is a bit of a euphemism for a circuit which essentially is binary valued or has two values.

The output has one of two values, typically a high voltage level or a low voltage level, and this flip-flop circuit alternates between one and the other.

Now, the purpose of this is twofold. First of all, in one state it provides a signal to the ball generator, which causes the displayed symbol, 113, Fig. 12B, to move either to the right or to the left.

So one of these leads, the lower lead, which is numbered 118, determines the horizontal motion.

The other influence of the Flip-Flop is to give control over the vertical motion of the spot to either Player A or to Player B, depending upon which one achieved coincidence with the spot.

So the last player to reach coincidence with his symbol or his spot and a ball has control, or some control, over its vertical motion, and he does so by virtue of a knob, either 127, in the case of Player A, that is, numbered 127 on Exhibit 89, or knob 128 on Exhibit 89.

The dash lines from knob 127 to the symbol numbered 125 indicate there is a mechanical connection between those two. When Player A rotates knob 127, he is actually changing the electrical position of a device called a potentiometer, and that enables him to have control over the voltage on the line numbered 119.

You will note that the line from 119 connects to the spot 3 generator and provides a signal

which influences the vertical motion of the spot, and I believe this is called English in some applications of this, the teachings of this patent.

Q Dr. Ribbens, you explained that according to the teaching of the '507 patent the game can either be attached to the R. F. antenna terminals on a television receiver or directly to the place that you marked "Video Signal" in Plaintiffs' Exhibit 86.

Can you point out in the '507 patent a figure which illustrates this alternate connection, where the game is attached directly to the video amplifier?

A I will have to refer to my copy of the patent.

(There was a brief interruption after which the following further proceedings were had herein:)

BY THE WITNESS:

A Yes, I think Fig. 18.

Q And -- go ahead. Others?

A I was going to say --

Q Is that also true in Fig. 19?

A Let's see. I have turned the page. Yes. The signal which corresponds to the video information is connected directly to the video amplifier from the spot generator.

Q And in Fig. 19, as I understand it, there is no blocks corresponding to the three that you left in white on Exhibit 86, namely the Radio Frequency Tuner, the Intermediate Frequency Amplifier, and the Video Detector, is that correct?

A That is correct.

THE COURT: I am sorry. Would you read that last question?

(Whereupon the record was read by the reporter as requested.)

BY MR. ANDERSON:

Q Now, you have explained at least partially how the game of Exhibit 89, as shown in block form, is played and what the function is of the various blocks in the play of the game.

Would there be any difference between the way those blocks functioned and the play of the game in the case where the game is attached to the antenna terminals versus where it is attached as shown in Fig. 19 of the patent directly to the video amplifier?

A No. The modulation of an RF oscillator simply permits you to enter the signals inthe television receiver without modifying it at all.

About using the RF oscillator and connecting the signal to the radio frequency tuner, you

are obliged to take the back off the television set and find the point in the circuit corresponding to the video amplifier and actually make a physical connection.

Q Now, if you will, just to make clear how these two alternate connections are possible, is it possible for you to relate in general the Fig. 19 block diagram which does not use an RF connection or an antenna terminal, and in general relate that, say, to the chart that you have on the easel, Exhibit 89, Fig. 12A?

A By "relate it" you mean the correspondence between the blocks?

Q Show the correspondence between the blocks and how they function.

A I will have to bring this copy of 19.

With reference to Fig. 19, you will see at the top there are two blocks labeled "Vertical Sync Sawtooth Generator" and "Horizontal Sync Sawtooth Generator". Those circuits provided the synchronizing pulses and the sawtooth voltages which are necessary to cause the beam to sweep and generate the raster.

Those correspond to the two blocks labeled numbered 115 and 116 of Exhibit 89.

Similarly, there are a set of blocks below

those, labeled "Spot 1 Generator" and then there is a dashed line down to"Spot n Generator". That implies, that "n", that such spots oan be generated by the teachings of this patent.

Q And "n" means what?

A It is an integer. It could be any integer.

Then there is a solid line from the dashed line to the block entitled "OR Gate and Pulse Shaper", which indicates that we combine the video signals from all n spot generators in a device which gives us a signal video waveform. That corresponds to the block labeled "OR Gate and Pulse Shaper" of Exhibit 89.

The horizontal and vertical oscillator and horizontal and vertical amplifiers are not shown on Exhibit 89, because they are part of the television receiver and would be part of the device to which the antenna terminals would be connected.

Q Are those shown on any other chart that you have been describing?

A Right. They are shown in the right-hand portion of the lower left, the horizontal deflection amplifier and vertical deflection amplifier.

Q On Exhibit 86?

A Excuse me. Yes. Exhibit 86.

Also shown on there is high voltage rectifier. That indicates a mechanism by which the high voltage -- I think I may have shown you when the back was off the television set that there is a lead which goes to the picture tube called high voltage. This Fig. 19 just happens to show that specifically.

You might note also that coming from the OR Gate of Fig. 19 is a line leading to a block labeled "Video Amplifiers", and then a line going from the video amplifiers to the symbol which represents the picture tube.

That corresponds in Exhibit 86 to the block labeled "Video Amplifier," that similarly goes to the television picture tube.

THE COURT: Did you indicate, counse, that you wanted to recess at 5:00 o'clock?

MR. ANDERSON: We thought that might be appropriate, your Honor, if it is acceptable to the Court.

THE COURT: I have no objection.

MR. ANDERSON: I think based on our present estimates, we still would hope to finish the plaintiffs' case this week.

THE COURT: All right.

We will recess now, then, until 10:00 o'clock tomorrow morning. We will go from 10:00 to 1:00.

(Whereupon an adjournment was taken herein at 5:00 p.m. to 10:00 a.m. of the following day, Wednesday, December 29, 1976.)